

MOULDING METHOD, CARRIED OUT BY A MOULD FOR A
CONVENTIONAL INJECTION PRESS, SUITABLE FOR COST-
EFFECTIVELY REALISING A PIECE IN ONE OR MORE INJECTABLE
MATERIALS, AND RELATIVE MOULD FOR SUCH A METHOD

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The present invention refers to a moulding method,
carried out by a mould for a conventional injection
press, suitable for cost-effectively realising a piece
in one or more injectable materials.

10 The invention also concerns a relative mould of such a
method.

In the field of injection moulding of thermoplastic
materials or other injectable materials, even metals
(in so-called "Metal Injection Moulding"), applications
15 which use the injection in sequence of one or more
materials are taking on ever increasing importance.

Amongst such applications, the most common refer to
products realised in two materials using the same mould
and the same succession of production steps. Typical
20 examples are: beakers and cutlery with the graspable
part in thermoplastic rubber, technical items together
with relative gaskets, soft on hard anti-slide grips,
panels, which may be transparent, with relative frame
and gasket, etc.

25 With time moulds intended for these moulding
applications have undergone an evolution which has led

to the realisation of tools intended for the production of the relative obtainable products.

Moreover, with the moulds conceived for this technology, it is also possible to mount, glue, join or
5 seal the pieces obtained by the tools themselves.

The state of the art of these tools can be summed up in the types which are indicated below.

A first type is the so-called rotary mould in which one of the two planes of the press is equipped with a
10 rotary table intended for the purpose. On such a table a semi-mould is mounted which rotates cyclically allowing the realisation, for every cycle, of a first portion which stays in the mould and a second portion on which a second material is over-moulded: at this
15 point the resulting piece can be removed.

This configuration is valid as a reference type for two or more materials and many impressions, and can be considered the most widespread method.

A second type is that in which a rotary mould, with
20 similar functions to the previous one, has kinematisms inside the moulding tool itself. It is used when the piece to be produced is shaped in such a way as to be realised just by replacing both the fixed side and the mobile side of the press, or else also when the press
25 on which the mould will be mounted is without a rotary table. In such a case a fundamental group of the tool

shall rotate, for example, like an element or impression carrying plate.

A third type is a mould rotating on an axis perpendicular to the axis of the press, with functions
5 similar to the previous one: inside the mould kinematics are foreseen which move a fundamental group like for example an intermediate element on which the impressions are mounted.

A fourth type is that comprising a mould which can
10 slide back, freeing a recess part, after a first injection, to be filled in a subsequent step. In this case the sliding back takes place during the cycle of the press.

A fifth type includes a translating mould, with a
15 similar function and cycle to the rotary one. With such a mould, in which there is a displacement step of a semi-mould, in general two different pieces realised in the mould itself are joined, sealing or joining them with a material which is placed between them. In this
20 way it is thus also possible to realise hollow bodies.

A sixth type comprises a translating mould equipped with trolleys. With such a mould, the moulding method is identical in type and function as the previous one, but in this case some parts to be joined can be
25 supplied by trolleys which feed the translated semi-mould part.

As stated, all of the mould types described above are dedicated moulds, realised for the purpose of producing a determined piece.

Therefore, they involve a large initial investment and, despite this, often the productivity obtained with them is not optimal.

The purpose of the present invention is therefore that of avoiding the drawbacks mentioned previously and in particular that of indicating a moulding method, carried out by a mould for a conventional injection press, suitable for cost-effectively realising a piece in one or more injectable materials, and that of realising a relative mould for such a method which allow details to be produced which in the prior art are realised through moulding presses, in general equipped with specific tools, or else through the assembly of components generally in different materials.

Another purpose of the present invention is that of indicating a moulding method, carried out by a mould for a conventional injection press, suitable for cost-effectively realising a piece in one or more injectable materials, and that of realising a relative mould for such a method which allow substantial reductions in production costs.

Another purpose of the present invention is that of indicating a moulding method, carried out by a mould

for a conventional injection press, suitable for cost-effectively realising a piece in one or more injectable materials, and that of realising a type of relative moulds for such a method which are particularly
5 reliable, simple and functional.

These and other purposes according to the present invention are accomplished by indicating a moulding method, carried out by a mould for a conventional injection press, suitable for cost-effectively
10 realising a piece in one or more injectable materials, as outlined in claim 1.

In claim 6 a relative mould for such a method is defined.

Further characteristics are foreseen in the other
15 claims.

The characteristics and advantages of a moulding method, carried out by a mould for a conventional injection press, suitable for cost-effectively realising a piece in one or more injectable materials,
20 and of a relative mould for such a method, according to the present invention, shall become clearer from the following description, given as an example and not for limiting purposes, referring to the attached schematic drawings in which:

25 figure 1 is a section view of a first embodiment of a mould according to the invention;

figure 2 is a plan view of a mobile part of the mould of figure 1;

figure 3 is a plan view of a fixed part of the mould of figure 1;

5 figures 4a, 4b, 4c, 4d, 4e, 4f and 4g show a section view of the mould of figure 1 in successive treatment steps;

figure 5 is a plan view of a mobile part of a second embodiment of a mould according to the invention;

10 figure 6 is a section view of a third embodiment of a mould according to the invention;

figure 7 is a plan view of a mobile part of the mould of figure 6;

figure 8 is a plan view of a fixed part of the mould of figure 6;

figure 9a is a section view of a fourth embodiment of a mould according to the invention;

figure 9b is a plan view of a mobile part of the mould of figure 9a;

20 figure 9c is a plan view of a fixed part of the mould of figure 9a;

figure 10a is a cross-section of a fifth embodiment of a mould according to the invention;

figure 10b is a longitudinal section of a fifth embodiment of a mould according to the invention;

figure 10c is a plan view of a mobile part of the mould

of figure 10a during a first semi-cycle;

figure 10d is a plan view of a mobile part of the mould
of figure 10a during a second semi-cycle;

figures 10e, 10f, 10g, 10h, 10i and 10l show a
5 longitudinal section of the mould of figure 10b in
successive treatment steps;

figure 11a is a plan view of a mobile part of a sixth
embodiment of a mould according to the invention,
during a first semi-cycle;

10 figure 11b is a plan view of the mobile part of the
mould of figure 11a, during a second semi-cycle;

figure 12a is a plan view of a mobile part in a seventh
embodiment of a mould according to the invention,
during a first semi-cycle;

15 figure 12b is a plan view of the mobile part of the
mould of figure 12a, during a second semi-cycle;

figure 13a is a section view of an eighth embodiment of
a mould according to the invention;

figure 13b is a plan view of a mobile part of the mould
20 of figure 13a;

figure 13c is a plan view of a fixed part of the mould
of figure 13a;

figures 13d, 13e, 13f, 13g, 13h and 13i show a section
view of the mould of figure 13a in successive treatment
25 steps;

figure 14a is a cross section of a ninth embodiment of

a mould according to the invention;

figures 14b, 14c, 14d, 14e, 14f and 14g show a cross section of the mould of figure 14a in successive treatment steps;

5 figure 15 is a plan view of a mobile part of a tenth embodiment of a mould according to the invention;

figures 16a, 16b and 16c show a half cross section of an eleventh embodiment of a mould according to the invention, in successive treatment steps;

10 figure 17a is a section view of a twelfth embodiment of a mould according to the invention;

figure 17b is a plan view of a mobile part of the mould of figure 17a;

figure 17c is a plan view of a fixed part of the mould
15 of figure 17a;

figures 17d, 17e, 17f and 17g show a section view of the mobile part of the mould of figure 17a in successive treatment steps, in which a displacement of a trolley takes place;

20 figure 18a is a section view of a thirteenth embodiment of a mould according to the invention;

figures 18b, 18c, 18d, 18e and 18f show a section view of the mould of figure 18a, in successive treatment steps;

25 figure 19 is a section view of a fourteenth embodiment of a mould according to the invention;

figure 20a is a section view of a fifteenth embodiment of a mould according to the invention;

figures 20b, 20c, 20d, 20e, 20f and 20g show a section view of the mould of figure 20a, in successive
5 treatment steps;

figures 21a, 21b, 21c, 21d, 21e, 21f, 21g and 21h show a cross section of a sixteenth embodiment of a mould according to the invention, in successive treatment steps;

10 figure 22a is a section view of a seventeenth embodiment of a mould according to the invention, at the start of treatment;

figure 22b is a plan view of a mobile part of the mould of figure 22a;

15 figure 22c is a plan view of a fixed part of the mould of figure 22a;

figure 22d shows a section view of the mould of figure 22a in a second treatment semi-cycle;

figures 22e and 22f are section views of alternative
20 embodiments of the mould of figure 22a;

figure 23a is a section view of an eighteenth embodiment of a mould according to the invention, at the start of treatment;

figure 23b is a plan view of a mobile part of the mould
25 of figure 23a;

figure 23c is a plan view of a fixed part of the mould

of figure 23a;

figure 23d shows a section view of the mould of figure 23a in a second treatment semi-cycle;

figure 24a is a section view of a nineteenth embodiment
5 of a mould according to the invention, at the start of treatment;

figure 24b is a plan view of a mobile part of the mould of figure 24a;

figure 24c is a plan view of a fixed part of the mould
10 of figure 24a;

figure 24d show a section view of the mould of figure 24a in a second treatment semi-cycle;

figure 25a is a section view of a twentieth embodiment of a mould according to the invention, at the start of
15 treatment;

figure 25b is a plan view of a mobile part of the mould of figure 25a;

figure 25c is a plan view of a fixed part of the mould of figure 25a;

20 figure 25d shows a section view of the mould of figure 25a in a second treatment semi-cycle;

figure 26a is a cross section of a twenty-first embodiment of a mould according to the invention;

figure 26b is a plan view of a mobile part of the mould
25 of figure 26a;

figure 26c is a plan view of a fixed part of the mould

of figure 26a;

figure 26d shows a longitudinal section of the mould of figure 26a in a first treatment semi-cycle;

figure 26e shows a longitudinal section of the mould of figure 26a in a second treatment semi-cycle;

figures 27a, 27b, 27c, 27d, 27e, 27f, 27g, 27h, 27i, 27j, 27k, 27l, 27m, 27n, 27o, 27p, 27q, 27r and 27t respectively show finished pieces produced with the twenty-one embodiments of a mould according to the present invention.

With reference initially to figures 1, 2 and 3, a mould is shown, wholly indicated with 10, for a conventional injection press, suitable for cost-effectively realising a piece in one or more injectable materials.

The mould 10 comprises two parts and more precisely a fixed part 12, which is attached to a fixed side of the press, and a mobile part 14, which is fixed to a mobile side of the press.

On the fixed part 12 and on the mobile part 14 of the mould 10 respective impressions are realised, which define, when the mobile part 14 of the mould 10 is closed against the fixed part 12, recesses 16 and 18 (in the example they are four in number) suitable for receiving the respective injectable materials.

A first recess 16 comprises at least one sliding element 20. In the example of figure 1 such elements 20

are two in number and are equipped with translating movement with respect to the fixed part 12 of the mould 10. In the specific example the sliding takes place along an axis substantially perpendicular to a longitudinal axis of the mould 10.

The sliding element 20, in its movement, successively reaches a second recess 18.

With the mould 10 shown in figures 1, 2 and 3 a piece is realised as a sleeve with inner gaskets, shown in figure 27a and where it is possible to see first parts 56 of finished part, realised in the first recesses 16, and second parts 58, realised in the second recesses 18.

The mould 10 uses a moulding method which comprises a succession of steps which are shown in sequence in figures 1, 4a, 4b, 4c, 4d, 4e, 4f and 4g.

In figure 1 it is possible to see a section view of the mould 10 at the start of a production cycle: on the sliding elements 20 are externally rested inserts 22, to define first recesses 16.

In figure 4a a first injection of an injectable material in such first recesses 16 takes place, to realise the inner gaskets, generally in thermoplastic elastomer.

After a cooling step of such an injected material, in figure 4b an opening step of the mould 10 is shown.

In figure 4c it is possible to see a removal step of feedheads with extractors and an opening step of inserts 22 which formed the first recesses 16.

Figure 4d shows a re-entry step of the extractors and a
5 displacement step of the sliding elements 20, to define a second recess 18.

In figure 4e it is possible to see a second injection step of an injectable material in such a second recess 18, which takes place after having previously closed
10 the mould 10.

After cooling of the injected material in the second recess 18, the mould 10 is opened and, as can be seen in figure 4f, there is a displacement of the sliding elements 20 in the position of figure 1, also with
15 removal of feedheads and of the finished piece. The finished piece is thus an element where the first injected material is connected to the second injected material, realising a sleeve with gaskets.

After the inserts 22 are once again made to advance and
20 the extractors are slid back, in figure 4g a subsequent closing step of the mould 10 is shown, which in practice coincides with figure 1 of the start of the cycle.

With the steps just described, the sliding elements 20,
25 mounted on sliding trolleys, carry the first injected and cooled materials into the second recess 18, where a

subsequent injection step takes place.

It should be highlighted how in figure 4f the trolleys, on which the sliding elements 20 are mounted, move back sliding off the sliding elements 20 themselves from the
5 gaskets.

Basically, it is thus possible to synthesise the steps of the moulding method according to the invention, carried out by a mould for a conventional injection press, suitable for cost-effectively realising a piece
10 in one or more injectable materials:

- a step of housing a sliding element 20 in at least one first recess 16;
- a first injection step in such a first recess 16, after which a first part 56 of such a piece remains
15 fixed on a surface integral to said sliding element 20;
- a displacement step of such a first part 56 of this piece in a second recess 18, through translating movement of such a sliding element 20 with respect to such a fixed part 12 of the mould 10;
- 20 - a second injection step in such a second recess 18.

It should also be highlighted that a first part 56 of the pieces produced with a mould 10 according to the invention can be moulded directly on an outer surface of the sliding element 20 or else on a surface in any
25 case integral with such a sliding element 20, such as an insert (or portion thereof), metal or otherwise. It

is thus possible to foresee steps of arranging, manually or with manipulators, inserts on such a sliding element 20, as well as in recesses of such a mould.

5 Moreover, it is also possible to foresee steps for carrying out various operations complementing the moulding operation, such as labelling, tampography, etc.

It is clear that further injection steps in further
10 recesses, besides the first and second recesses 16 and 18, can also be foreseen.

It should also be noted that, given the small inner side of the sleeve, to realise this piece with known technologies it would have been necessary to use a
15 dedicated rotary mould.

Consequently, with the same size, a complex tool would be realised with trolleys on a rotary plate which is not very productive.

The method described above, applied to this type of
20 elements, allows productivity many times greater.

In figure 5 it is possible to see a second embodiment of a mould 110 according to the invention, where the components which are the same as and/or equivalent to those illustrated in figure 2 carry the same reference
25 numerals increased by 100. In practice, this is a variant of the mould 10 which allows a sleeve with six

inputs to be realised, which is shown in figure 27b.

Figures 6, 7 and 8 illustrate a third possible practical embodiment of a mould 210 according to the invention, where the components which are the same as
5 and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 200. In this example, a body is produced equipped with an inner gasket similar to a sealing connector, which is shown in figure 27c.

10 In figures 9a, 9b and 9c a fourth embodiment of a mould 310 according to the invention is shown, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 300. In this variant a
15 sleeve is produced in series, shown in figure 27d and able to be realised in very small sizes and similar to an aid for sealably joining tubes or electrical wires.

In figures 10a, 10b, 10c and 10d a fifth embodiment of a mould 410 according to the invention is shown, where
20 the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 400. This variant is an evolution of the mould 10 of figure 1. In this case a sleeve is realised in five parts, due to the
25 particular configuration of the gaskets: such a sleeve is shown in figure 27e.

More precisely, first of all, in a first semi-cycle, gaskets are moulded in first recesses 416 and a central part is moulded in further recesses 417 of sleeves (possibly in two different materials), as can be seen
5 in figures 10e, 10f and 10g. Then, in the subsequent semi-cycle, as is shown in figures 10h, 10i and 10l, the central parts are conveyed through a guided insert 421, where such further recesses are housed 417, the insert being connected to a table in the subsequent
10 position near to the second recesses 418. Then, on the gaskets, pressed against a central part of the sleeve, parts are overmoulded which stably connect the components. In figure 27e first finished piece parts 456, further parts 457, realised in the further
15 recesses 417, and second parts 458 can be seen.

It should be noted that in this step the sleeve is kept empty inside and is thus like a hollow body.

In figures 11a and 11b a sixth embodiment of a mould 510 according to the invention is illustrated, where
20 the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 500. In this variant a sleeve is produced of the same type as the one realised with the mould 10 of figure 1, with the
25 sole difference that this time it has a curved shape. Such a finished piece is shown in figure 27f.

In figures 12a and 12b a seventh embodiment of a mould 610 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 10c and 10d carry the same reference numerals increased by 200. In this variant a curved sleeve is produced obtained from many pieces overmoulded with a procedure similar to the one explained for the mould 410 of figure 10a. Such a finished piece is shown in figure 27g.

10 In figures 13a, 13b and 13c an eighth embodiment of a mould 710 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 700.

15 With this mould 710 a flat surface is realised equipped with side gaskets: such a finished piece is shown in figure 27h. In a first step perimetric pieces are moulded and in the second step the flat surface is moulded, as shown by the succession of figures 13d, 13e, 13f, 13g, 13h and 13i. This type of piece is usually realised with rotary moulds or moulds with sliding backwards of a part to be fed in the second injection.

In figure 14a a ninth embodiment of a mould 810 according to the invention is illustrated, where the components which are the same as and/or equivalent to

25

those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 800. With this mould 810 a flat surface similar to the one produced with the mould 710 of figure 13, but having a framed box-shaped structure, is realised: such a finished piece is shown in figure 27i. It should be noted that the process allows the perimetric parts with a complex form and non-constant section to be realised, as can be seen in figures 14b, 14c, 14d, 14e, 14f and 14g.

10 In figure 15 a tenth embodiment of a mould 910 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 900. With this mould 15 910 a distributor is realised equipped with relative gaskets. Such a finished piece is shown in figure 27j.

In figures 16a, 16b and 16c an eleventh embodiment of a mould 1010 according to the invention is illustrated, where the components which are the same as and/or 20 equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 1000. With this mould 1010 an eyeglass frame is realised complete with arms and relative hinges with an elastic joint: such a finished piece is shown in figure 27k.

25 It should be noted that in this case the sliding element 1020 takes up three different positions: in

figure 16a the sliding element 1020 realises a first recess 1016, in figure 16b the sliding element 1020 defines a further recess 1019 and in figure 16c the sliding element 1020 forms a second recess 1018. It
5 should be specified that in figure 27k first finished piece parts 1056, further parts 1059, realised in the further recess 1019, and second parts 1058 can be seen. The technology would furthermore allow the steps to be implemented, for example also gaining lenses, for
10 example made from poly(methyl metacrylate) PMMA, from the sequence.

In figures 17a, 17b and 17c a twelfth embodiment of a mould 1110 according to the invention is illustrated, where the components which are the same as and/or
15 equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 1100. With this mould 1110 a valved cap is realised in which the chemical link between elastomer and perforated support is not desired and therefore the support shall
20 be used as the base for a patella which acts as a valve. Such a finished piece is shown in figure 27l.

It should be noted how also in this case the finished product is realised in a simple manner if compared with that which is allowed by moulds for overmoulding of the
25 prior art. At the kinematic level it is interesting to note that a trolley which conveys the first shot inside

the second recess follows a non-linear movement so as to avoid collisions with the walls of the recess, as shown in the sequence of figures 17d, 17e, 17f and 17g. In figure 18a a thirteenth embodiment of a mould 1210 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 1200. With this mould 1210 a body with inner and outer gaskets of complex composition is realised: such a finished piece is shown in figure 27m. In this case sliding elements 1220 on which the gaskets are moulded in a first semi-cycle interpenetrate to be arranged for a second injection step, as can be seen in the sequence of figures 18b, 18c, 18d, 18e and 18f.

The replacement of the recess is ensured by the lowering of a descending core on which trolleys close. A trolley is moved by a column and the removal of the piece is ensured, in this case, by the stopping in telescope sequence. The second trolley is also moved by a tilted column and a jack takes care of the displacement for the change of stroke.

In figure 19 a fourteenth embodiment of a mould 1310 according to the invention according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1,

2 and 3 carry the same reference numerals increased by 1300. This mould 1310 is an alternative of the mould 1210 of figure 18a with positioning of the axis of the piece parallel to the axis of the press. The finished
5 piece produced is shown in figure 27m.

In figure 20a a fifteenth embodiment of a mould 1410 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same
10 reference numerals increased by 1400. With this mould 1410 a kinematism is realised, using non-chemically adhesive materials such as acetal POM and polyamide PA6.

Such a finished piece is shown in figure 27n.

15 It should be noted how in such an example, sliding elements 1420 displace horizontally and vertically alternately, as can be seen in the succession of figures 20b, 20c, 20d, 20e, 20f and 20g.

In figures 21a, 21b, 21c, 21d, 21e, 21f, 21g and 21h a
20 sixteenth embodiment of a mould 1510 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 16a, 16b and 16c carry the same reference numerals increased by 500. In this case a sliding
25 element 1520 comprises an impression part 1516 or 1518, so that such an impression 1516 or 1518 translates

following one or more stages. At each stage an injection step or a different operation like labelling or other takes place.

In the example a three layered beaker is realised,
5 shown in figure 27o.

In figures 22a, 22b, 22c and 22d a seventeenth embodiment of a mould 1610 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1,
10 2 and 3 carry the same reference numerals increased by 1600. With the mould 1610 pieces similar to those produced with the mould 1510 of figure 21a are realised, but more specifically the mould 1610 is balanced and translating with two increasing stages of
15 the element. The finished piece produced is shown in figure 27p.

We would now like to give particular attention to this last application of the method according to the invention, carried out with the aforementioned mould
20 1610, given that it can advantageously alternatively be applied to cases in which one currently opts for the rotary mould.

In particular we wish to point out big advantages, productive and otherwise, with respect to the methods
25 of the prior art.

In the example, for the sake of simplicity, we refer to

a rubber beaker, but of course the example is not limiting and it could be any type of similar article.

A press for producing a determined article is chosen according to three fundamental rules which concern, in
5 order of importance, the necessary closing force, the size of the mould and the capacity, for plastification and injection capacity, of the punching screws.

The prior art directs the production of such an item towards the use of a mould on a press with a rotary
10 table in which to obtain two finished beakers for every cycle.

Clearly, in each cycle the two materials shall be injected simultaneously in such a way as to form two first shots and two second shots moulded over the
15 first, to realise the finished product. In practice, the mould consists of four identical punchers which rotate cyclically and four identical dies in pairs wherein on the first two the first shots are generated and on the second pair of dies the rubber part and thus
20 the finished beaker shall be obtained.

The necessary press must have a sufficient closing force to mould in the four recesses. The bulk of the mould is such as to be able to rotate on the table and between the columns of the press. The plastification
25 screws must be sized so as to feed the sufficient material capacity for every moulding cycle. The mould

usually obtainable tends to be unbalanced since one tends to divide the sequences into pairs each side of the mould, so as to feed them congruently with the screw intended for the injection step, and also for
5 reasons of lifting or dropping of the pieces produced for every cycle.

Such a solution apparently seems extremely optimised since for every cycle finished pieces ready for extraction are obtained, and moreover the punching
10 screws inject material in each cycle.

It should not be forgotten that, given that it is the press that rotates the half-mould, the necessary mould has a relatively low cost which can easily be made to have less impact over the number of pieces which have
15 to be produced, of course compared to the use of a more expensive press.

Let us now analyse how the mould 1610 designed following the moulding method of the present invention is composed and what are the advantages which it
20 offers.

The mould 1610 is mounted on a press without a rotary table. The mould 1610 comprises a fixed part 1612 formed from eight identical dies in sets of four of which those for second injection (although it could
25 also be the opposite) occupy a central part of the mould 1610, whereas a mobile part 1614 is formed from

four sliding elements 1620.

Such sliding elements 1620 comprise translating punchers in pairs so as to be able to converge or diverge simultaneously during opening in two semi-cycles. In the first semi-cycle, with the punchers 1620 apart, a body of the beaker is moulded injecting the first material in the four corresponding dies. In the second semi-cycle, after having clearly moved the punchers 1620 closer together, a rubber material is overmoulded on top.

At this point, after having opened the mould 1610 and removed the four finished pieces, the four punchers 1620 once again displace into separated position so as to be able to restart with an initial step.

The described mould 1610 conforms to needs and the press used. The necessary closing force is indicatively the same given that four impressions of the same size shall always be moulded in each injection of material even if with divided steps.

Not having to carry out rotations of the mould 1610, the necessary bulk will involve a press plane which is bigger but which does not create problems given that it must only satisfy the requirement of the passage size between the columns of the press.

Overall, the necessary plastification capacity, since the injection cycles are divided, is a less important

prerogative even if such a method actually allows more plastic to be transformed in the unit of time: this is due to the fact that, to plastify more than double the amount of material, there is relatively more time
5 available, in virtue of the fact that the punching and maintenance time of the material is cyclically less.

The moulding method which uses such a mould 1610 allows a more rational use of the press and a total balancing both of mass and of distribution of the forces in play.

10 The movement of the parts, indeed, concerns mass incomparable to the rotation system and thus involves low displacement times.

Clearly, to justify the investment of a relatively more expensive mould 1610, due to four necessary extra dies
15 and the translating kinematisms, the productive advantages must be substantially big.

Let us now generally analyse a productive comparison of the two moulding methods, relative to the estimable transformation times.

20 With a rotary mould of the prior art there are the following times:

0.5 s for the injection of the first and second material;

10 s for the cooling of the injected material;

25 3.5 s for the opening of the mould, the removal, the rotation and the closing of the mould.

Therefore, the total time to produce two finished beakers is 14 s.

With the mould 1610 according to the invention, with translating and balanced sliding elements there are the following times:

0.75 s for the injection of the first material;

10 s for the cooling of such a material;

1.5 s for the opening of the mould 1610, the translation of the sliding element 1620 and the closing of the mould 1610 itself;

0.75 s for the injection of the second material;

10 s for the cooling of such a material;

3 s for the opening of the mould 1610, the removal of the finished pieces, the translation of the sliding element 1620 and the closing of the mould 1610 itself.

Therefore, the total time for producing four finished beakers is 26 s.

From this first comparison it emerges that it is just about more productive to realise a mould not of the rotary but translating type. This is thanks to the lesser time necessary for moving the parts. Such a difference is truly minimal and deserves a closer analysis, given that an extra 7% productivity and the already quoted advantages in terms of balancing and use of the press justify only in rare cases a greater amortisation given by the greater cost of the mould

necessary.

From a deeper analysis, in reality, other important factors emerge which influence the productivity of the moulding method according to the invention:

- 5 - the preliminary analysis does not take into account that, in fact, the thicknesses and the capacity of the two materials used are never the same and thus require substantially different cooling times;
- during the first semi-cycle four dies shall
10 alternatively remain disengaged and can cool down further: this allows a further decrease in the cycle time given that, once used, they cool down the shot quicker substantially decreasing the cycle time and, moreover, allow, with semi-crystalline polymers, the
15 obtainment of a higher level of crystallinity, a characteristic sometimes desired on some manufactured products;
- the injection times, since the capacities are different, are also different.
- 20 Thus reconsidering the previous analysis in reasonable terms concerning the materials used, we can thus reconsider the times of the mould 1610 according to the invention in the following way:
0.75 s for the injection of the first material;
- 25 9.25 s the cooling of such a material;
- 1.5 s for the opening of the mould 1610, the

translation of the sliding element 1620 and the closing of the mould 1610 itself;

0.5 s for the injection of the second material;

5 s for the cooling of such a material;

5 3 s for the opening of the mould 1610, the removal of the finished pieces, the translation of the sliding element 1620 and the closing of the mould 1610 itself.

Therefore, the total time for producing four finished beakers is 20 s.

10 In this case the difference between the mould 1610 according to the invention and the prior art seems substantial and there is a saving in terms of transformation time equal to 28% in favour of the method according to the invention with respect to the
15 rotary mould normally applied.

It therefore becomes reasonable to invest in tools of this type since the amortisation on the number of pieces can boast a considerable difference in terms of transformation cost.

20 It seems clear that such a productive method is all the more preferable the greater the difference in terms of capacity and thickness between the materials to be injected.

Moreover, reconsidering the same configuration of the
25 mould 1610 this time not to produce beakers but for example containment boxes with high-thickness walls

equipped with a perimetric gasket, we can thus compare the estimation between the two productive methods.

With a rotary mould of the prior art there are the following times:

5 2 s for the injection of the first and of the second material;

28 s for the cooling of the injected material;

4 s for the opening of the mould, the removal, the rotation and the closing of the mould.

10 Therefore, the total time to produce two finished containment boxes is 34 s.

With the mould 1610 according to the invention, with translating and balanced sliding elements there are the following times:

15 2.5 s for the injection of the first material;

26 s for the cooling of such a material;

1.5 s for the opening of the mould 1610, the translation of the sliding element 1620 and the closing of the mould 1610 itself;

20 1 s for the injection of the second material;

8 s for the cooling of such a material;

3.5 s for the opening of the mould 1610, the removal of the finished pieces, the translation of the sliding element 1620 and the closing of the mould 1610 itself.

25 Therefore, the total time to produce four finished containment boxes is 42.5 s.

In this case the difference in production time is considerable and there is a saving in terms of transformation time equal to 37% in favour of the method according to the invention with respect to the
5 rotary mould of the prior art.

The substantial productivity, together with the technical advantages of exploitation of the press and of balancing thus makes it truly important to invest in tools of this type.

10 In figures 22e and 22f a further two alternative embodiments of the mould 1610 of figure 22a are shown, where the components which are the same as and/or equivalent to those illustrated in figure 22a carry the same reference numerals respectively followed by the
15 suffix b and c. Such moulds 1610b and 1610c realise the same method carried out by the mould 1610, but in these last two cases the moulds 1610b and 1610c are of the so-called "stack" type: in the prior art this term indicates double or multiple moulds, i.e. formed from
20 three or more moulding planes.

More precisely, the mould 1610b has a central moulding plane equipped with dies, whereas in the case of the mould 1610c in the central moulding plane there are punchers.

25 In figures 23a, 23b, 23c and 23d an eighteenth embodiment of a mould 1710 according to the invention

is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 1700. With the mould 1710, which in practice is a
5 further development of the mould 1610 of figure 22a, a toothbrush body is realised. Such a finished piece is shown in figure 27q.

The mould 1710 is multi-impression and is equipped with a double table device which follows an impression which
10 in turn translates on a guide connected to a first table. To limit the inertial stresses of the masses of the displaced impressions, a screw is used actuated by a motor instead of by a jack as can happen, on the other hand, in the previous examples.

15 In figures 24a, 24b, 24c and 24d a nineteenth embodiment of a mould 1810 according to the invention is illustrated, where the components which are the same as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by
20 1800. In the mould 1810 the translation takes place between the elements. The finished piece produced is shown in figure 27r.

In figures 25a, 25b, 25c and 25d a twentieth embodiment of a mould

25 1910 according to the invention is illustrated, where the components which are the same as and/or equivalent

to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 1900. The mould 1910 is similar to the mould 1810 of figure 24a, but in this case steps are taken to translate impressions
5 linked to trolleys instead of puncher impressions. The finished piece produced is shown in figure 27r.

In figures 26a, 26b, 26c, 26d and 26e a twenty-first embodiment of a mould 2010 according to the invention is illustrated, where the components which are the same
10 as and/or equivalent to those illustrated in figures 1, 2 and 3 carry the same reference numerals increased by 2000. In the mould 2010 the elements remain connected to the fixed part of the mould. The finished piece produced is shown in figure 27t.

15 Basically, the moulding method of the present invention tends to move, mainly, the parts of partial impressions through movements which convey a first shot into a position suitable for receiving a second injection cycle. Such a cycle can be in two or more sequences and
20 always between the sequences a displacement takes place helping to make the end piece grow by overmoulding.

Moreover, it should be noted how the method according to the invention can be divided for macro regions of the mould, thus creating growing islands which at a
25 certain point can also generate the end product between them.

At the kinematic level, therefore, the substantial difference of the present method with respect to the panorama of existing methods is that an entire semi-mould or fundamental group of the tool will not move
5 but individual impression parts constituting the end piece; or else, individual groups of impressions translate with stages necessary for the sequential growth and are commanded by kinematisms totally inside the tool.

10 We would now like to highlight that, forgetting the individual applications and the details of the individual cases, it seems clear that the moulding method according to the invention becomes extremely important amongst the realisation and design methods of
15 the tools used for the construction of pieces made up of many overmoulded and/or multicomponent materials.

From the description which has been made the characteristics of the moulding method, carried out by a mould for a conventional injection press, suitable
20 for cost-effectively realising a piece in one or more injectable materials, and of the relative mould for such a method object of the present invention, are clear just as the relative advantages are also clear, amongst which we recall:

25 - production costs of the finished details substantially lower with respect to the prior art;

- the masses of the mould in movement are minimal and therefore the displacements necessary for the growth of the piece are faster and more agile;
- the mould is perfectly balanced by mass, injection
5 and forces applied on the press;
- with the method according to the invention the impressions are not cyclically replaced, thus making a number of openings and closures of the mould equal to the necessary growth sequences necessary;
- 10 - the method tends to realise some of the types of pieces currently realised with known methods in a more productive manner (more pieces per hour) in particular in relation to the rotary mould;
- the method tends to realise some of the types of
15 pieces currently realised with known methods with less complex and expensive moulds and in particular with rotary moulds with kinematisms inside the tool and with moulds with sliding back which make part of the recess accessible;
- 20 - the method allows some types of pieces which are difficult to realise with known methods, if not, as seen, pieces actually unable to be realised with the prior art to be realised advantageously;
- the moulding method according to the invention is
25 also useful for realising pieces in polymeric materials not compatible with each other: in such a way it is

possible to obtain not individual pieces but groups of pieces mounted together and constituting a complex object like, for example, kinematisms or other;

- the method requires just a common injection press
5 uniquely equipped with a management unit suitable for the management of the signals to be communicated with the moulding tool and equipped with injection groups necessary for obtaining the piece: in practice, the method makes the type of press have no influence upon
10 the complexity of the mould;

- the method is an open system suitable for being implemented and/or supported by the multiple types of mould already existing and by the numerous miscellaneous functions normally outside the tool like
15 for example setting, in some sequences, inserting, labelling, tampography operations, etc.;

- the method lends itself to overmoulding pieces realised also with water-soluble materials like for example polyvinyl alcohol PVAL, in order to obtain
20 pieces otherwise not able to be realised, which are hollow or interpenetrating;

- with the method of the present invention there is substantial possibility of developing and engineering new products with improved characteristics;

25 - possibilities of large design revisions of the pieces realised with known methods and of pieces not currently

designed because they are unable to be realised with the prior art.

Finally, it is clear that the moulding method, carried out by a mould for a conventional injection press, 5 suitable for cost-effectively realising a piece in one or more injectable materials and the relative mould for such a method thus conceived are susceptible to numerous modifications and variants, all of which are covered by the invention; moreover, all of the details 10 can be replaced with technically equivalent elements. In practice, the materials used, as well as the shapes and sizes, can be whatever according to the technical requirements.

The scope of protection of the invention is therefore 15 defined by the attached claims.